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ABSTRACT

Instructional designers need to be able to understand and apply virtual reality to enrich learners' experiences. This paper examines the nature of virtual reality, how it applies to education, and rationales for using virtual reality in the classroom. The following instructional design guidelines for helping instructional designers to create a new learning environment are outlined: (1) provide divergent learning outcomes; (2) focus on learner-centered control; (3) provide a high level of user interaction; (4) follow the principles of instructional design; and (5) consider constructivist learning principles. (Contains 15 references.) (AEF)

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Trends and Issues in Instructional Design and Technology

Instructional Design Guidelines for Virtual Reality in Classroom Applications

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Introduction

When a new technology is introduced into education, there is a tendency to adapt and utilize it for instructional purpose. As a growing movement, virtual reality has showed its potential to educators. Since 1990s, the research conducted on virtual reality shows some enthusiastic school systems are adapting this technology for their students. With the result of utilizing this technology in education settings, researchers suggest some positive and some negative reactions from other educators. Therefore, it is appropriate at this time to look back and plan for the future to apply the potential of virtual reality in classroom setting.

As instructional designers, we should be able to understand and apply the new advanced technology to enrich the learners' experiences. Thus, how to design this brand new technology will be a hot issue for the instructional design field. It would be valuable at this time for educators, policy makers, as well as business groups to think about applying virtual reality in the classroom.

What is the virtual reality? How can virtual reality apply to education? What should instructional designer consider when designing an instructional virtual environment? How is the learning in virtual reality different from or similar a traditional learning environment? Responding to the above three questions is the primary purpose of this paper.

Definition

Known as cyberspace, artificial reality, or synthetic reality, virtual reality has been defined as a highly interactive, computer-based, multimedia environment in which the learner becomes a participant with the computer in a virtually real world (Franchi, 1995). It is a process that enables learners to become participants in abstract spaces where the physical machine and physical

viewer do not exist (Helsel, 1991). Thus, Virtual reality can be defined as a computer generated sensory learning environment that allows learners to participate in responsive way so that they will become engaged in full body-brain kinesthetic learning. In short, there are five common components in the definition of virtual reality: (a) involvement, (b) immersion, (c) learner control, (d) presence, and (e) active interaction.

History and Applications

Virtual reality is a combining concept that comes out of several sources, stretching over a long period of time. Efforts to produce life-like environments go back many years. Since the late 1920s, the Link Trainer, a flight simulator, has been used to train pilots. Head-Mounted Display System (1950s), Data Glove and Three Dimensional Sound System (1970s) were implemented in the virtual reality research area. A number of virtual reality applications have been tested since 1980s. <Table 1> shows the applications that have been conducted in various area.

Area	Application
Education	• Modeling complex phenomena • The design of interactive forms of entertainment and learning • Telepresence, including virtual field trips • The design of experiential learning environments (special education)
Telerobotics	• To allow the observation, sending, and manipulation of objects in locations inaccessible to humans, such as dangerous environments or remote locations (communication and control at a distance)
Architects	• To walk through entire building, mall or facility of their designs • To evaluate proposed changes of the city renovation plan
Entertainment	• To provide virtual experience in s three-dimensional environment
Medicine	• To discover the best treatment plan for the real patient
Auto Industry	• To test for comfort and convenience through different arrangements • To redesign automobiles

<Table 1> Applications of Virtual Reality

In 1994, the virtual reality modeling language (VRML) was appeared to the public. Basically, VRML has been using conventional World Wide Web platform. It can be embedded into the HTML documents so that learner can explore the virtual learning environment on the Internet.

Rationales for Using Virtual Reality in the Classroom

Virtual reality can extend the conventional classroom environment into other realities. It could provide an experience that is transferable and enriches learners' non-virtual reality (Henderson, 1991). This new learning environment can be comparable to a simulation mode of conventional computer assisted instruction. The following two reasons can serve as rationales for using virtual reality in a classroom setting:

Firstly, by reflecting the real world, the simulated environment gives a learner the chance to try out different options without danger, expense, or extended time consumption. One may also try out the different scenarios that are actually impossible to do in the real world, and determine which scenarios present the best chance of accomplishment.

Secondly, it can be highly motivating learning process. Active participation is required. A learner, who is engaged in a virtual learning environment, cannot be just an observer. The high levels of interaction and individualization promote intense interest. In this way, virtual reality offers a new form of experience that can be instructive.

Principles for Instructional Design

Stuart and Thomas (1991) suggest that virtual reality environment might play a role in practical applications. Exploration, interactivity, construction, and manipulation are critical in this learning environment. To provide a more appropriate virtual learning environment, the following

instructional design guidelines should help instructional designers to create a new learning environment.

1. *Provide divergent learning outcomes*

   In the virtual reality learning environment, individuals have to put themselves into the realistic and interactive environment. Thus, their jobs will be exploring the virtual environment with their own learning strategies. In the virtual learning environment, the objectives of the intended learning would be the same as conventional instruction. However, the learners' path to these objectives would be different from conventional instruction.

   Because of the immersive nature of virtual reality, it can serve as a useful instructional medium in some particular settings. Those situations are (a) when dangerous real-life scenarios are involved, (b) when a setting that would otherwise be inaccessible is involved, and (c) when detailed demonstrations or illustrations are needed (Dennen and Branch, 1995).

2. *Focus on learner-centered control*

   When designing virtual learning environment, instructional designers should focus on control that allows learners to customize their learning experience to fit personal needs and interests. Constructivist claims that learners can only interpret information in the context of their own experiences, and that what they interpret will, to some extent, be individualistic. Designers may intend to map a particular reality for learners, but ultimately the learner's interpret the messages in the context of their own experiences and knowledge, and construct meaning relative to their own needs, backgrounds, and interests (Jonassen, 1991).

   Virtual learning environments can remove the abstract nature of a topic and increases spatial understanding through sensory stimuli. Abstract concepts are more easily learned when presented in a visual form (Krueger, 1991). Besides, the symbolic or graphic feedback provided in virtual provided in virtual environment will be stronger than verbal presentations in the conventional learning environment.

3. *Provide a high level of user interaction.*

One of the key features of the virtual learning environment is its potential to permit an intuitive, real time interaction with three dimensional graphic environments and databases. It is, therefore, perceived to be a valuable method for productive exploring design solutions.

Interaction has been cited as an important part of the instructional design process. In an instructional virtual environment, it is more important because the learner should navigate and control the environment. For this reason, the environment should permit and require learners to maintain an active participation. Therefore, many interactions should be designed, tools for interaction and exploration should be included, and teachers should be able to communicate with learners in the virtual environments, and as a result learning activities will be encouraged within the virtual environment.

To design a high level of interaction, instructional designers should consider user-friendliness, built-in tools for interaction and exploration, a way for teachers to enter and interact within the environment, and allowance for learner experimentation and expression (Dennen and Branch, 1995).

4. *Follow the principles of instructional design*

One of the major contributions of instructional design is to allow instructional designers to create conditions of effective learning environment by considering internal and external learning factors which affects successful learning. Therefore, providing well-constructed virtual environments will be served as the most appropriate tools for learning. The other contribution is iterative nature of systematic design process. This process stresses a continuous improvement so that the previous stage of learning environment will be revised over the time to provide the most appropriate environment. In this process, instructional objectives will be a critical part of the overall process.

5. *Consider constructivist learning principles.*

The virtual learning environment will facilitate the learner's individual construction of meaning from presented stimuli. The experience-based nature of virtual learning needs to attend constructivist principles when designing virtual learning world. Constructivist values can be used to guide the instructional design process, suggesting that the synergy

of instructional design principles and constructivism will provide effective virtual learning experiences. Design principles of constructivist learning environments suggested by Cennamo, Abell and Chung (1996) are helpful:

- Provide complex learning environments that incorporate authentic activity
- Provide social negotiation as an integral part of learning to allow insights to emerge through the group process
- Juxtapose instructional content and include access to multiple modes of representation to allow learners to examine materials from multiple perspectives
- Allow reflexivity or awareness of one's own thinking and learning process
- Emphasize students centered instruction where students are actively involved in determining their own learning needs and how those needs can be met

Conclusion

Virtual reality may soon become the standard method in various areas such as design, planning, manufacture, selling, and project management, etc. However, there are, at present, a few useful or usable applications of the virtual reality design tolls available to education.

It seems that the field of virtual reality has not yet realized its own identity. Most of the research findings focus on the nature of computer interface rather than practical application to education. Virtual reality has the potential to shift from a conventional learning environment to a futuristic, but appropriate, learning environment for individual learners. Combined with a constructivist model, a conventional instructional design model should be useful for instructional designers to design and develop the virtual learning environment in this transitional stage. This virtual reality learning environment is likely to effect the delivery mode of a conventional learning process in the future.

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